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Special Issue Introduction

Science and decision making in biological control of weeds: Benefits and risks of biological control

This special issue of *Biological Control* presents a series of articles from an invitational conference titled "Science and Decision Making in Biological Control of Weeds: A Conference on the Benefits and Risks of Biological Control." The conference was jointly hosted by the United States Department of Agriculture (USDA), Agriculture Research Service, and United States Department of the Interior (USDI), National Park Service, and was held in January 2004 in Denver, Colorado. It was sponsored by the USDA Cooperative State Research Education and Extension Service through an IFAFS (Initiative for Future Agriculture and Food Systems) Consortium Grant on biologically based control of invasive weeds (Agreement Number 00-52103-9647). Through this grant, a multi-institutional and multi-disciplinary Guidance Committee was formed to plan the agenda, invite speakers and participants, and design a meeting format that would foster dialogue and constructive discussion among groups and individuals with divergent perspectives on the benefits and risks of biological control (for program and speakers, see http://groups.ucanr.org/saltcedar). Logistics for this meeting, participant travel, and local arrangements were organized by Janet Clark, of the Montana Center for Invasive Plant Management; Nai Saelee, of the USDA-ARS, Exotic and Invasive Weed Research Unit, Albany, California; and Linda Drees of the National Park Service, Invasive Species Program, Ft. Collins, Colorado. Special thanks is given to Dr. Raghavan Charudattan (Charu), who both participated in this conference and arranged for this issue of *Biological Control*, and to Dr. Andy Sheppard, who joined us with Charu as editors for this special issue.

The goal of the conference was to bring together a wide range of specialists to address critical issues facing policy makers, scientists, and land managers interested in using biological control to aid in weed management. The concept of the workshop was not simply to rehash differences of opinion regarding potential benefits and risks of biological control but rather to begin a cooperative dialogue on ways to resolve conflicts and move forward on issues linked to the scientific and decision making processes supporting invasive weed management. Over 100 participants were involved in listening and responding to approximately 50 formal presentations. Participants were also involved in breakout groups focused on a range of topics important to this controversial topic. Emphasis was placed on how current scientific knowledge, methodological approaches, and future research can improve predictive ability and decision making for invasive weed management and regulatory action. Key decision makers from both USDA and USDI policy and funding agencies attended the conference with the goals of incorporating presented concepts and approaches into future policy and funding plans. This has already begun to occur through decisions made by the Invasive Species Council, via the efforts of Gordon Brown, Hilda Diaz-Soltero, and others. Based on the interests of conference participants and organizers in continuing discussions and codifying presentations, subsets of the presentations that provided new scientific information or a forward-looking synthesis of existing information were grouped into this special issue of *Biological Control*. We hope that these papers will provide further insights and impetus for future research into benefits/risk assessments for biological control decision making and implementation.

Many introduced species have caused extensive damage to valued resources in both natural and managed ecosystems and thus have warranted extensive human intervention and resource allocation. Invasive plants, for example, can alter rangeland quality, interfere with crop yields, cause population declines in valued native species, and dramatically change ecosystem functioning and thus have been the focus of many programs for assessment and control. The US Departments of Agriculture and the Interior and many other state, county, and other governmental institutions have developed a wide range of assessment and control programs to help stop the introduction, spread, and negative impacts associated with some invasive species. Biological control is just one of a number of tools that are being used to combat invasive weeds. Classical biolog-

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ical control is recognized as one of the best means of dealing with well-established invaders, as it alone has the capacity to control pests over wide areas with little economic cost once a successful program has been researched and implemented. Classical biological control, however, does involve potential risks to nontarget organisms and critical ecosystem processes and, as many readers are aware, there have been concerns expressed in recent years regarding nontarget impacts caused by the introduction of exotic natural enemies as classical biological control agents. Both direct and indirect negative impacts have been cited, thus raising fears that biological control risks are not always well considered. At the same time, others have pointed to the environmental and economic benefits of successful biological control as a justification for continued biological control programs even if some risk is involved. Based on the benefits provided and a relatively unsoiled environmental record, many practitioners have disputed or discounted the extent of the environmental concerns that have been raised.

In reality, biological control has the potential to help reduce populations of many invasive species, but it is not risk or cost free, as are no other methods of pest control. An open discussion of these areas of concern has been needed for many years along with increased dialogue on methods to limit negative side effects while maximizing the beneficial outcome of this technology. We designed this conference to bring together experts in conservation biology, plant and insect ecology, and biological control, along with a group of land management and regulatory specialists responsible for the control or regulation of introduced species on a day-to-day basis, in order to foster a new or expanded dialogue. Participation of real-world decision makers helped to keep the discussions on track and away from bipolar philosophical perspectives, which often highlight either benefits or risks alone. In the past, individual perspectives on the risks and benefits of biological control have been wide-ranging but often one-sided, and sometimes presented in a sensational or confrontation manner. Such perspectives have not always been productive in helping to understand or resolve on-the-ground problems that decision makers are forced to address. In this conference, we attempted to lay all the issues on the table without confrontation in order to evaluate critical factors that must be addressed to improve the science and associated decision-making processes.

Benefit/risk assessment and analysis provide an excellent framework within which information from all sides of the issue can be collated and compared while still allowing decisions control efforts to move forward. For that reason, several case studies using different benefit/risk analyses are presented here, along with a range of examples representing different scientific considerations important for the biological control decision making process. The papers present a wide range of perspectives and in total point out the need for careful experimentation and creative, ecologically based considerations of both risk and benefit. The breakout discussions that followed these presentations are not summarized here, but each session ended in ideas for further cooperative work and a commitment to continue working to better use our current knowledge to improve biological control benefit/risk assessment and modeling. Several regulatory specialists expressed that risk/benefit approaches held promise to increase the effectiveness and processes developed to oversee biological control permitting decisions.

As conference conveners, we ask you to read these articles with an open mind and visualize their implications from alternative perspectives. We encourage people interested in invasive species management to confront the challenge of developing safe and effective biological control programs in a proactive fashion and work cooperatively to assess biological control as one of several potential tools with which to manage targeted species and achieve desired goals that go beyond merely establishing agents. By working cooperatively locally and regionally, we should be able to better determine where and when the use of biological control is safe and effective, and thus appropriate. Together, we should be able to use our ecological knowledge to better guide action programs and assist decision makers to focus biological control technologies in ways that maximize their effectiveness while better integrating them with other methods of control and restoration towards desired habitat conditions.

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